REVIEWS.

ART. XVIII.—*Mittheilungen aus dem kaiserlichen Gesundheitsamte. Herausgegeben von* DR. STRUCK. Zweiter Band, Berlin, 1884.
Report of the Imperial Health Office. Edited by DR. STRUCK. 13 chromo-lithographic plates and 13 wood-cuts.

SINCE the appointment of Dr. R. Koch as one of the officers of the German Board of Health some five years ago, the laboratory of that institution has turned out scientific work of remarkable value. It is not apparent from any of its publications whether the members of the board have any official duties, but, however that may be, Koch and his co-labourers are at liberty to spend most of their time in original research in the line of etiology and hygiene. The first volume of Mittheilungen appearing in 1881 is a work of permanent value. Its description of accurate and precise methods in the study of micro-organisms, and especially the direction for the cultivation of bacteria on dry soil, render it an indispensable book of reference to the student of that subject. It completed furthermore Koch's researches on the etiology of anthrax, and presented studies on various experimental infectious diseases of animals. Not the least important topics were the researches on disinfection, which, while they informed us of the unreliability of many agents hitherto employed, showed us the trustworthiness of corrosive sublimate, and the relative merits of many other substances for that purpose. It is but faint praise to state that no trials with disinfectants had previously been made with any similar thoroughness. The work of most immediate practical value in that volume was the employment of escaping steam for the disinfection of large parcels, which mode of disinfection was found far more practical and reliable than dry heat.

Since the issue of the first volume Koch has published his famous discovery of the bacillus tuberculosis; Loeffler and Schütz have discovered the bacillus of glanders; Becker has proven osteomyelitis to be due to an invasion of micrococci; and now the activity of the laboratory is illustrated by the rich contents of the second volume of the Mittheilungen.

The work begins with the full account of KOCH's *Studies on the Etiology of Tuberculosis.* It contains the details of the work more explicitly than the shorter publication in 1882, besides some additional matter. Since the previous account of these researches has reached a popularity which perhaps no other medical work has ever enjoyed, we can review it more hastily on the assumption that much of it is well known. Koch begins with an explicit description of the methods for staining the tubercle-bacilli, stating his preference for the method discovered by Ehrlich subsequently to his own. He emphasizes the fact that, of all known bacteria, none behave towards the aniline colours and the decolorizing acid like the specific tubercle-bacilli, except the bacilli of leprosy. Statements to the contrary he attributes to faulty manipulation. The *spores* of mould-fungi and of a variety of bacilli found in the normal intestinal contents also present the same peculiarities. He points out, moreover, that this exceptional behaviour to staining fluids simply facilitates the search for the bacilli, but is nowise necessary to establish their specific nature. After describing the morphology of the bacilli, he studies their distribution in the diseased tissues.

The number of bacilli in the tubercular tissues may vary enormously. Where the tubercular degeneration is either stationary or receding, there are so few as to make their detection difficult, though they can always be found with patience, while, where the disease progresses rapidly, their number is so immense that the entire microscope field may appear blue with a low power, when a blue staining fluid has been used. The fact that there are so few bacilli in old stationary lesions has been misinterpreted by many. Yet, as far as we know, the virus of other infectious diseases disappears from the system, or at least the part involved, when the lesion recedes toward a cure. The bacilli are found mainly in the interior of the epithelioid cells constituting the tubercle, and especially in the so-called giant-cells, which are sometimes filled with a wreath of bacilli. But the bacilli do not persist indefinitely, but die and disintegrate, so that in old lesions with caseous degeneration either none are left at all, or only their spores, which do not take up the staining material. The presence of the spores was proved by the infectious properties of the cheesy material. Since the bacilli possess no mobility, their transfer from one spot to another is passive as far as they are concerned. Their transportation in the tissues Koch attributes to the white blood-corpuscles which take up a bacillus and with it continue their migration, until the pernicious influence of the parasite, which they have swallowed, causes their destruction. Thus the invasion spreads from the first tubercular deposit into the vicinity. Moreover, in some rare specimens he found a growth of bacilli perforating into a small vessel, sometimes an artery, sometimes a vein, thus explaining the occurrence of metastatic deposits in distant parts by their transportation in the blood current. The one point particularly emphasized by Koch is that wherever the incipient stage of the tubercular process can be studied, there *the bacillary invasion of the healthy tissues invariably precedes the tubercular infiltration.*

The thoroughness of Koch's work is made evident by his summary of pathological specimens examined, viz., the lungs of 29 cases of phthisis, the different organs in 19 instances of miliary tuberculosis, 13 various isolated tubercular processes in kidneys, testicles, etc., 13 tubercular joints, 21 scrofulous glands, and 7 cases of lupus. In all but the latter two classes bacilli were found with invariable constancy, though not in every slide in the more chronic lesions. In the scrofulous glands they were met with as long as the tubercular structure was still distinct, their number being however quite small. Where complete caseous degeneration had occurred, or where the glands had broken down into abscesses, the bacilli could no longer be detected. In four cases of lupus, excised bits of skin showed the bacilli in very limited number in the interior of giant cells; in three other instances only the material scraped off with the curette was to be had, and could not be examined satisfactorily, but its tubercular nature was proven by the positive result on inoculating rabbits in the anterior chamber of the eye. In some seventy instances observations were made on the spontaneous tuberculosis of horses, cattle, sheep, goats, pigs, chickens, monkeys, rabbits, and guinea-pigs. It was thereby learned that the appearance of natural tubercular lesions is quite peculiar to each species, but in all instances the bacilli were found. It is almost needless to add that in extensive examinations of healthy and morbid, but non-tubercular tissues, these bacilli were never met with.

The industry and perseverance displayed in these studies are almost without parallel in the annals of pathological work. If we take into account that Koch states only what he has actually seen, and not what he might conceive, abstaining altogether from theoretical speculations, it seems fair to demand at least some equivalent work of the few who venture to attack Koch before we listen to their speculations.

In order to complete the proof of the role of the bacillus as the cause of tuberculosis, some 500 animals of different species were inoculated with the specific bacilli. In every instance of the disease thus produced the characteristic bacilli reappeared in the lesions. In a small number of the animals the tubercular products of man or animals were used as such, but in most instances a pure culture of the bacilli was employed. In order to put the validity of his results in the proper light, Koch points out that, on account of the ventilation and cleanliness in the care of the animals, spontaneous tuberculosis appeared but very rarely in his stables, and then only in animals which had been confined there for many months. Furthermore the spontaneous tuberculosis can be distinguished readily from the results of inoculation by the greater dissemination of small tubercles in the latter case, and the localized spread of the disease from the point of infection. During the time of these experiments, several hundred other animals, serving other purposes, were inoculated with other bacteria or non-tubercular disease-products *without contracting tuberculosis in a single instance.*

The cultivation of the bacilli succeeded satisfactorily only on the surface of solidified blood serum. They form a dry scum consisting only of bacilli, which do not penetrate into the soil. When thus isolated they do not differ in appearance or behaviour to staining fluids from the parasites in the living body. Their growth is very slow, and requires a warmth between 29° and 42° C. On account of this sensibility to temperature, their fastidiousness as to the composition of the soil, and their slow growth, which permits other bacteria to crowd them out of existence in any but pure cultures, the important conclusion of Koch seems fully justified, *that the bacilli of tuberculosis are limited to a parasitic mode of life in animals, and cannot grow outside of the body under the conditions found in nature.*

The isolated bacilli, suspended in sterilized water or serum, were injected partly under the skin, partly into the peritoneal cavity, and in other instances into the anterior chamber of the eye. In every experiment on rabbits, guinea-pigs, cats, chickens, pigeons, and field-mice, the tubercular process began in the inoculated spot, and spread thence to the adjoining lymph-glands, culminating finally in generalized miliary tuberculosis. The acuteness of the process depended pretty directly on the quantity of bacilli employed. The bacilli neither lost nor changed their pathogenic properties by growing on the artificial soil for months, and in some instances over a year. Nor could any differences be detected in the results, were the bacilli derived in the first place from typical cases of human or animal tuberculosis or phthisis, from fungous joints, from scrofulous glands, or from lupus of the skin. The inevitable conclusion is, therefore, *that all these morbid processes are due to the same virus, the* *character of the pathological lesion depending on the number and localization of the bacilli and on the power of resistance of the tissues of the patient.* This power of resistance, or, as we might term its reciprocal, "the predisposition," is evidently not the same in all individuals, and not in all species. Rats and common mice are not very susceptible to tuberculosis. In several experiments, inoculation with small quantities of material proved harmless to them, although a more energetic infection succeeded invariably. Dogs resist the tubercular virus within certain limits. One animal infected in the abdominal cavity presented during several weeks evidence of decided sickness, the symptoms being the same as in other dogs undoubtedly tubercular. This one, however, recovered fully, the only instance of recovery in Koch's experience. Five months later, a second infection with tubercle-bacilli succeeded again, and produced a fatal generalized tuberculosis. No immunity was granted by the first attack, an observation fully in accord with clinical experience.

Some of the most interesting experiments were made with a spray of water containing bacilli in suspension. In a large box placed in the garden, rabbits, guinea-pigs, rats, and mice were made to inhale this infectious spray for half an hour on three consecutive days. Every one of these animals presented at the post mortem tubercular disease of the lungs, with a deposit of tubercles in other organs proportionate in extent to the lapse of time between the infection and its death. The tubercular nature of the nodules in the lungs was proven by their structure, the presence of bacilli in them, and their infectious properties on inoculating other animals with them. The symptoms during the life of the animals corresponded to the extent of the lesions.

The information that can be derived from these researches as regards the origin of tuberculosis in man Koch sums up as follows: The sputum of every phthisical patient contains at most times, if not always, the characteristic bacilli. The sputum, as experiments prove, is infectious, and retains its disease-producing properties even on drying for many days, and, if spores be present, which is true very often, for several months. During expectoration, and while the sputum remains moist, there is very little opportunity for the bacilli to get into the air to form part of the floating dust. Hence there is no reason why we should expect the presence of consumptives to endanger others by direct contagion. But the sputum dried on the floor or on the handkerchief is converted into dust by the friction and mechanical violence to which it is always subjected. Bacilli thus suspended in the air can cause pulmonary tuberculosis, as proven by experiments. Spontaneous tuberculosis begins, in the majority of cases, in the lungs, while all experiments show that the process always starts from the point of infection. Consumption being so prevalent as it is, we are therefore exposed to the virus in all ordinary localities, and it is a question simply, whether in a given case the inhaled bacilli can get a foothold. Since their growth is very slow, their chance of entering through the intact surface of the lungs is small, if the motion of the ciliated epithelium is active, and if there is no accumulation of mucus. It is evident how previous diseases, like measles, which deprive the mucous membrane of its protecting epithelium, or conditions like adhesions of the pleura or diminished thoracic mobility, which may lead to stagnation of bronchial fluids, can favour the first invasion of the lungs by the bacilli. The progress of the disease then depends on the number of bacilli which have entered and on the reaction of the tissues. If leucocytes take up the bacilli to any extent, and transport them for short distances in the tissues, or carry them into the lymphatic glands, the surface of contact of the body with the virus is thus enlarged, and the spread of the parasites facilitated. If, on the other hand, the spot where they have settled gets surrounded with a barrier of granulation tissue, the further invasion is for the time being checked. How to explain the predisposition in one case, the power of struggling victoriously with the parasites in another, is not yet possible on any direct evidence. The infection of distant localities in the body occurs in various ways. If the sputum from one part is aspirated into another bronchial tube during the effort at expectoration, the disease may be started in a fresh lobule of the lung. If the bacilli-vegetation extends through the wall of a bloodvessel, a sudden infection of distant organs is the evident result, while a more chronic auto-infection may occur by the transport of leucocytes, each laden with a bacillus, along the currents of the lymph-vessels. Finally the consumptive who swallows his own sputum exposes himself to secondary tuberculosis of the intestines, a complication by no means rare, although the sputum does in many cases pass through the canal without infection.

Primary tuberculosis of the intestinal canal, while very uncommon, may be produced by eating tubercular material containing spores. Since, in the case of cattle with pearl disease, the nodules are pretty sure to be removed by the butcher, the danger of eating their meat—the non-infected muscles—may not be great. The milk would likewise not be infectious, except when the tubercular process invades the mammary gland, which is not common. There seems to be some danger also from pork, as Koch found not rarely the occurrence of tubercular glands in hogs.

In the case of fungous disease of the ends of bones, the tubercular nature is established by all the criteria that can be applied. The bacilli can reach these spots only by means of the blood-current. Their point of origin is, however, a matter of speculation, though analogy points strongly to tubercular bronchial glands as the source of such infection. In the minute infected spot in the lungs and in the involved gland, the disease may be at a standstill in such cases.

Tubercular infection of superficial wounds or post-mortem scratches is not likely, if at all possible, in man. Even in the most susceptible animals, the slowly-growing bacilli are eliminated, unless they are put into a protected locality. The differences between the clinical course of lupus and of other tubercular affections Koch does not try to explain. The tubercular nature of lupus, however, as far as the etiology is concerned, he maintains on the strength of the presence of the bacilli and of the infectious properties.

The most critical perusal of Koch's paper leaves no impression but that of unqualified admiration. The language is so plain, the logic so perfect, the interpretation of everything seems so self-evident, that no flaw can be detected. There is nothing smoothed over, and where a gap exists in our knowledge, it is openly shown. The amount of work done seems almost superfluous in view of the harmony of the results. But, as the result of the work, tuberculosis can now rank with anthrax as the most perfect instance up to date of etiological knowledge. It is fair to predict that amongst future assailants of Koch's work there will be very few men of judgment who have read the work in the original.

The second essay in the volume is a statistical research by A. WUERZBURG, the librarian of the health office, *On the Influence of Age and Sex* *upon the Prevalence of Pulmonary Tuberculosis.* He based his calculations on the very accurate census reports of Prussia, an immense material, comparing also the statistics of other States. He arrived at results somewhat at variance with former opinions on account of calculating in a manner different from the usual computations. With able arguments he points out that the most correct results can only be obtained by *comparing the death-rate with the number of living persons of the same age,* provided a correct basis is to be had. By means of this calculation, it turns out that, contrary to the usual view, the earlier period of adult life is not the most prone to consumption, but that the danger from this disease increases with the advance of years, also that the mortality during infancy is considerable. An extract from his largest table shows these striking figures :—

Of 10,000 individuals	aged	0–1	year	there die annually	of consumption	$23\frac{45}{100}$.
"	"	1–2	years	"	"	$20\frac{41}{100}$.
"	"	5–10	"	"	"	$4\frac{66}{100}$.
"	"	15–20	"	"	"	$18\frac{37}{100}$.
"	"	20–25	"	"	"	$30\frac{24}{100}$.
"	"	25–30	"	"	"	$36\frac{73}{100}$.
"	"	30–40	"	"	"	$41\frac{12}{100}$.
"	"	50–60	"	"	"	$67\frac{94}{100}$.
"	"	60–70	"	"	"	$93\frac{18}{100}$.
"	"	70–80	"	"	"	$61\frac{72}{100}$.
"	"	over 80	"	"	"	$25\frac{80}{100}$.

In Prussia males are more prone than females on taking the average of all ages. Similarly the inhabitants of cities show a greater mortality than dwellers in the country. But on tracing separately the mortality of the sexes at different periods of life, in cities and in the country, certain differences are found, which taken in connection with the known habits of the people point pretty strongly to the injurious influence of confinement in insufficiently ventilated rooms.

The succeeding article, by Dr. GAFFKY, refers to *the constancy with which the characteristic tubercle bacilli are found in the sputa of consumptives.* During three months a daily examination of only one slide a piece was made of the sputa of a number of patients under observation in hospital. Of fourteen patients each one was examined at least some twenty times on consecutive days. In twelve of these cases 982 examinations were made with 95.5 per cent. of positive results, while only in 4.5 per cent. the bacilli were not found. It is to be remembered that only one slide was searched at a time. The importance of this result for diagnostic purposes is evident.

Two other cases require special comment. One of these with slight infiltration of both apices of the lungs showed no bacilli the first seven times, subsequently they were found six times in eight days. After fifty-one subsequent negative examinations he left the hospital very much improved. The second one, with slight consolidation of the left apex, showed some four to six bacilli in each microscopic field the last days of December, a less number on the first two days of January, then none at all during the following three months, with the exception of one day in March. At the end of that month he died of a perforation of the intestines due to swallowing a number of plum kernels. The autopsy revealed no active tubercular process, but merely a small calcified spot in one lung and slaty induration of both apices. Whether this cure of the disease might have remained permanent is left an open question.

The Disinfection of Tubercular Sputa was studied by Drs. SCHILL and FISCHER by inoculating series of animals with the sputa before and after exposure to the substances employed. At first dried sputum was employed. But it was learned that between the one-hundredth and two-hundredth day its virulence had become uncertain, and the experiments made with it are therefore not stated as conclusive. Subsequently only the fresh, moist sputum was used, although repeated trials proved that putrefaction during fully six weeks did not diminish its virulence. In other observations dried sputum, not over two weeks old and decidedly virulent, was tested for comparative purposes. It was learned that dry heat of 100° C. was not reliable, but that the bacilli and their spores dried on cloth could be destroyed with certainty by exposure to a current of steam at the ordinary boiling-point within a short time. In the case of even large parcels like bedding, to be disinfected, one hour's exposure is amply sufficient. Fresh sputum could be rendered harmless by boiling within five minutes, but for the disinfection of larger quantities the time of half an hour is recommended. Of a large number of chemical disinfectants tested carbolic acid was found the most reliable and economical, but still of this agent a five per cent. solution in quantity equal to that of the sputum was found necessary, with twenty-four hours' exposure, in order to get reliable results. Corrosive sublimate is not available in spite of its potent antiseptic action, since it produces a precipitate with sputum which prevents the penetration into the interior of the expectorated masses.

In the next contribution KOCH, GAFFKY, and LOEFFLER state their observations on *the Attenuation of the Bacilli of Anthrax in order to Procure Immunity* against the disease by vaccination. Most of these results were published about one year ago in Koch's reply to Pasteur. While they confirm the scientific importance of Pasteur's researches, they differ from him in many practical details on which the value of the plan depends. The capital discovery of Pasteur that the cultivation of the bacillus anthracis in neutralized chicken-broth at a temperature of 42° to 43° C. lessens gradually its virulence to animals was at once confirmed. But contrary to Pasteur's view the cause of this change was not found in the influence of oxygen, but in the effect of the high temperature, for the rapidity of the attenuation depended directly on the exact degree of heat. Inoculation with such attenuated virus did not confer immunity against severe attacks on rabbits, guinea-pigs, or mice. These animals did not lose their susceptibility to the disease by any number of mild, nonfatal infections. But sheep could, indeed, be rendered less susceptible by preventive vaccinations, not, however, with the certainty or infallibility that Pasteur claims. In his various communications Pasteur does not state what tests he applies to his vaccinal matter in order to gauge its virulence. By tedious trials the German investigators filled this gap. They found that the first inoculation of sheep was both safe and yet effectual, if the virus could still produce fatal anthrax in mice, but not in guinea-pigs, which corresponded to some fifteen days' cultivation at the high temperature. The second vaccine virus must be of a strength to kill guinea-pigs, but spare rabbits. The two forms of virus put into the market under Pasteur's directions do, indeed, possess this relative virulence. Not satisfied with two vaccinations Koch and his assistants inoculated some of their sheep four times with bacilli of increasing virulence, and still the immunity was not absolute in every case, when tested by inoculation with blood of an animal dead of the intense form of the disease; for some of the sheep thus protected still succumbed. Pasteur's brilliant public demonstrations of the efficacy of his protective vaccinations can be only explained by assuming that he tested the resistance of his animals with a virus less virulent than that employed by the German investigators.

The practical value of protective inoculation hinges on the question, whether the natural mode of infection is any more, or whether it is less dangerous to the vaccinated animal than the artificial inoculation under the skin. Pasteur speaks of the natural infections as less dangerous, but without giving any proofs. It was therefore attempted to imitate the natural mode of infection by feeding the animals with the virus. If bacilli without spores be used for this purpose, they are destroyed by the acid in the stomach, and hence prove harmless. But the spores, when hidden in potatoes which were pushed into the animal's throat, passed the stomach uninjured, and could then germinate in the contents of the intestines. The result of such feeding experiments on sheep varied with the amount of spores employed. Pills of spores of the size of a pea killed the animals invariably within one to two days, while small traces of spores produced the disease only after an incubation of six to eight days, as is usual in anthrax occurring naturally. Moreover, when very few spores or very old spores were fed not every animal succumbed, evidently because in such a case the spores may leave the intestines with the feces before the growing bacilli have time to enter the intestinal wall. The autopsy showed that the bacilli resulting from the germination of the spores gain entrance into the system through the mucous membrane of the small intestine, and especially through the Peyerian patches, which appear inflamed. These are also the lesions in the natural form of the disease; hence feeding with spores ought to be the test of the immunity produced by vaccination.

Five sheep vaccinated with Pasteur's virus, and five others vaccinated with virus mitigated in the Berlin laboratory, had been inoculated with virulent anthrax material under the skin, and had survived. These ten animals, which should now enjoy the most perfect immunity, were fed with large quantities of spores with the result of two deaths, while the other eight had actually acquired an absolute immunity. This immunity persisted on repeated trial nine months later.

Since a vaccination sufficient to protect the animals against experimental anthrax-infection produces a certain loss by itself by killing a small percentage, since the natural mode of infection is even more dangerous than experimental inoculation, and since the second vaccine virus must necessarily be so virulent as not to be harmless to other animals or man, Koch and his assistants claim that Pasteur's vaccination is at present of doubtful practical value.

It is doubtful whether this severe judgment is wholly unbiased. Admitting the truth of his premises, it must still be remembered that the number of spores which an animal is likely to swallow naturally is very small compared with Koch's enormous doses. After all it is less important, practically, whether the immunity is absolute, than that it should be sufficient to leave the farmer a balance of cash in his favour on comparing the costs of vaccination and the slight loss produced thereby with the loss which his experience has taught him to figure on annually in unprotected animals. Even vaccination with cowpox is not an absolute guarantee against smallpox. The large statistics of Pasteur have certainly shown that, as a matter of national economy, the protective vaccination against anthrax is more of a success than would appear from the severe censure of it by the German board of health.

Dr. HESSE contributes, in the next place, a paper on the *Quantitative Determination of the Micro-Organisms in the Air.* He points out that it is of no service to be able to demonstrate more or less germs caught on a slide, for the point of importance to know is, whether these germs are still capable of growth, or whether they are dead. If the germs in the air are caught, on the other hand, by passing the air through nutrient solutions, it is impossible either to recognize what varieties existed in the air, or even how many of the germs there are, for the most actively growing variety will soon fill the solution, crowding out the less vigorous species. But by the application of Koch's method of culture on solid soil the dust floating in the air can be analyzed quantitatively and qualitatively. For this purpose a glass tube, some 70 centimetres long and 3.5 centimetres wide, is partly filled with a nutrient gelatine, is closed at one end with a rubber cap, and connected at the other hand with a smaller tube plugged with cotton. This apparatus is then sterilized by a current of steam. Where the air is then to be examined an aspirator is attached at the smaller end, and the rubber .cap is removed, all this with antiseptic precautions. As the air passes slowly over the gelatine in the horizontal tube all floating particles settle on the layer, but only on the lower horizontal surface of the tube. At the rate of 1 to 4 litres of air drawn through per minute none of the suspended germs reach the cotton plug at the further end, indeed they mostly settle near the open end of the tube. According to the amount of dust in the air a half litre may suffice, or 100 litres may be necessary for quantitative estimation. On keeping the tube warm, but below the melting-point of the gelatine for several days, every deposited germ, if living, will develop into a visible colony of micro-organisms, each colony representing but one species. Their number can then be readily counted, and if desired each colony can be identified by transplantation on a fresh soil, and appropriate tests applied as to its fermentative or pathogenic properties.

The work of developing the method seems to have filled Dr. Hesse's time, so as to leave as yet no time for any extensive application of it or qualitative analysis of the results. It was learned, however, that germs are more frequent in inhabited rooms than in the open air in proportion to the movements of persons in the rooms. Furthermore, that damp weather reduced the number of suspended germs considerably, affecting least the spores of mould fungi. There were fewer germs found in the higher than in the lower strata of the air. In the open air there were sometimes as few as four germs in 20 litres of air, while in a rag-assorting shop every litre of air contained hundreds of living micro-organisms.

On examining air drawn through thick layers of sand or common soil, it was found that all dust had been retained by this filtration, and no germs developed on the gelatine. Similarly it was learned that brick and various building materials were impenetrable to bacteria, even in thin strata. Through very thin layers, however, the spores of mould fungi could penetrate. This seems singular, since these spores are much larger than bacteria. Microscopic examination of the colonies furnished the interesting explanation, that mould-spores float in the air by themselves, while bacteria always adhere to the surface of larger, though still microscopic, motes.

In the following essay Prof. SCHUETZ studies two *Mycotic Affections of Birds.* An epidemic amongst geese in a yard near Berlin was found to be essentially a croupous pneumonia. In the lungs and air-sacs of the animals a mould fungus was seen, which, on artificial cultivation, proved to be aspergillus fumigatus. By inhalation of the spores of this fungus healthy birds could be infected, and the typical disease reproduced. It was also learned that aspergillus niger could vegetate in the lungs of living birds, while the more common aspergillus glaucus showed no pathogenic properties.

By similar methods of pure cultivation and inoculation it was shown that the crusts on the cock's comb, known as tinea or favus of poultry, are also a mycotic affection.

Drs. FISCHER and PROSKAUER tested *the Disinfectant Power of Chlorine Gas.* Pure cultures of many pathogenic bacteria, as well as non-pathogenic micro-organisms, both with and without spores, also mould fungi and yeast, were exposed to the fumes in a large glass bottle. The test-objects were partly dry, partly moist; some were directly exposed, others were hidden in packages. The percentage of chlorine gas, as well as the degree of dampness of the air, was varied in different experiments. Accurate record was kept of all the conditions, and successive estimations of the amount of chlorine remaining were made during each experiment; at the end of each experiment all the samples of micro-organisms were planted on a gelatine soil, so as to test their survival, while the virulence of the pathogenic varieties was, moreover, tested by inoculation. The effect of the exposure on each species could thus be rigidly determined. The amount of work represented by the paper must have been enormous, and it is, moreover, of the most painstaking character.

It was learned that the disinfectant effect of chlorine, very slight in dry air, increased with the moisture of the atmosphere. When the air was quite damp, but still far from the point of saturation, one volume per cent. of chlorine killed all micro-organisms and their spores inside of twenty-four hours, and those exposed in thin layers even in three hours.

On testing the practicability of disinfection with chlorine on a large scale in the basement of the building, the results were much less satisfactory. In spite of the utmost care in pasting strips over and plugging all cracks and openings around windows and doors, the percentage of chlorine in the air could not be kept constant, but diminished quite rapidly. Moreover, it was not evenly distributed throughout the rooms, and did not seem to enter nooks and corners sufficiently. It was also found difficult to maintain a sufficient degree of moisture of the air. Hence, the result was that only those test-objects which were exposed in thin layers and in the most favourable parts of the room were thoroughly disinfected, while micro-organisms hidden in packages or placed in spots less accessible to the gas were not destroyed with certainty. Clothes, moreover, were injured by the chlorine to such an extent as to render their disinfection impracticable. Such articles, however, can be well disinfected with escaping steam. Still, the authors consider chlorine as the most efficient agent at present available for the disinfection of such localities as cannot be purified by washing all objects and surfaces with fluid antiseptics, for it can be relied upon, if properly used, to destroy at least all superficially exposed germs, while their own researches proved bromine inferior in that respect, and those of Wolfhuegel, made three years ago in the same laboratory, showed the unreliability of sulphurous acid. The necessary one per cent. of chlorine gas requires the use of 0.25 kilo chloride of lime, and 0.35 kilo crude muriatic acid per cubic metre space.

The contribution by Dr. HUEPPE, on *the Decomposition of Milk by Micro-Organisms*, is the first systematic application of Koch's methods in the investigation of bacteria causing fermentations. Former observers had either studied the chemical side of the question exclusively, or had used insufficient methods in their examination of the bacteria concerned. The principles involved in Hueppe's work were the use of thoroughly sterilized milk, which was infected, when desired, with pure cultures of bacteria grown on a solid soil of nutrient gelatine. He shows, by a review of the literature, that, in spite of many contradictions, milk drawn from the udder with antiseptic precautions, but *without* the addition of any antiseptic chemicals, will never sour or curdle. The successful experiments of Roberts, Lister, Cheyne, and Meissner show that this is possible, though possible only with some skill and in localities kept more than usually clean. At any rate, the successful experiments prove that souring and curdling of the milk are always due to micro-organisms, which get in after it leaves the gland. Since it is so difficult to gather the milk uncontaminated, it was sterilized by heat. This can be done by as low a temperature as 70° C., but in order to destroy spores, it must be applied an hour at a time for five consecutive days. For during this time any spores present begin to germinate, and thus lose their power of resistance to heat. A temperature of 100° C., obtained by a current of steam, will sterilize the milk absolutely in less than forty-five minutes. But boiling produces slight chemical changes, which must be kept in view. These are precipitation of the serum-albumen, to which a trace of the casein clings mechanically. The boiled casein, moreover, is not curdled quite as readily by the action of rennet, while it is precipitated by acids as well as in the fresh milk. The stomach digestion of milk is therefore somewhat impeded by boiling. Continued boiling also splits up the milk sugar to a slight extent.

The micro-organisms which cause the souring of milk are to be found in every sample of milk obtained in the usual way, in most cases together with other bacteria. By transplantation on a solid soil where no currents or movements of fluid cause the different varieties to intermingle, any one species can be isolated. Although Pasteur, Lister, and others had correctly described the appearance of the lactic acid bacteria, they had incorrectly named them micrococci. High lenses and staining show them to be very short but thick rods; they belong hence to the genus bacillus. Like other bacilli, they produce permanent spores, which, however, readily escape detection in the milk on account of the high refractive index of the milk-serum. On account of these spores, milk is not preserved indefinitely by boiling it for only a short time. These bacilli convert milk-sugar and other sugars in nutrient solutions into lactic acid with the production of some bubbles of carbonic acid. The utmost extent of acidity to which they can give rise is 0.8 per cent., but if the acid be neutralized by the addition of chalk, they will ultimately transform all the sugar present. The curdling of the milk is due only to the acid formed, not to any direct action of the bacilli upon the casein. Their activity is greatest at a temperature between 35° and 42° C.; above 45° C. they are paralyzed. They exert no fermentative action on other substances as far as the examination went, with the exception of a feeble diastatic effect on starch. The action on sugar is due to the growth of the living bacilli, and could not be traced to any chemical ferment, which they might secrete, as has been supposed by others. The lactic acid bacilli cannot attack sugar in the total absence of oxygen. They require, however, but very little of that gas. Since, within certain limits, their activity increases with the amount of oxygen at their disposal, Hueppe cannot admit the correctness of Pasteur's hypothesis that fermentation is life without oxygen.

In the description of the bacilli which cause butyric acid fermentation, Hueppe agrees with various previous authors. He adds that these bacilli cannot attack sugar, but that they can only convert the lactic acid, previously formed by the other bacteria, into butyric acid. They have the ability to curdle the casein in neutral solution like rennet, and subsequently re-dissolve the coagulum with the formation of pepton and some other albumen derivatives, amongst which are ammonia and some bitter products.

Hueppe's investigation of the bacteria causing the blue colour of milk, when it undergoes that singular fermentation, furnished again a strong argument in favour of Koch's views of the stability of bacterial species. Previous studies of this blue change in milk made some few years ago by Neelsen had apparently shown some striking metamorphoses of the micro-organisms concerned, when they were cultivated in different media. In fact Neelsen's experiments seemed hitherto one of the best supports of the view that bacteria have no absolute constancy of form. Hueppe, however, shows in the most convincing manner that Neelsen committed gross errors in not using sterilized milk and pure cultures of his bacteria. It turns out in this case, as well as in every other sufficiently investigated, that the characteristics of bacterial species are just as definite and constant as in the case of higher plants. The article concludes with some studies of other colour-producing bacteria.

Dr. GAFFKY describes in the next paper his researches on *the Etiology of Typhoid Fever*. From his excellent summary of the literature, it appears that hitherto three different varieties of micro-organisms have been observed in that disease. Von Recklinghausen was the first to detect colonies of *micrococci* in the internal organs of typhoid cadavers. The same have since been seen by others, but their presence is not constant. Later on Klebs described thin bacilli growing out into very long filaments, which he had found in the ulcerated patches of the intestines, and seen in some instances also in internal organs. Others, however, Meyer and especially Koch (in the first volume of the "Mittheilungen"), pointed out that Klebs's bacilli are scarcely ever seen except in the most superficial strata of the necrotic Peyerian patches, in which exposed locality, the presence of bacteria, growing in from the intestinal contents, is to be expected, without indicating any causal relation to the disease. Entirely different bacilli were found by Eberth in the Peyerian patches, mesenteric glands, spleen, and some other organs of typhoid cadavers. They were short rods with rounded ends, arranged in characteristic colonies. Their staining was found rather unsatisfactory, at least with cold solutions. They could be distinguished from bacteria found in other diseases, but they were not present in more than one-half of the cases examined. The more advanced the disease the less likely were they to be found. Independently of Eberth, Koch had made similar observations and had furnished photographs of these bacteria in the first volume of these reports. Meyer and Friedlander likewise confirmed the results.

Gaffky's own researches were made on the organs of twenty-eight typhoid cadavers with the result of finding the characteristic bacilli colonies of Koch and Eberth in some of the viscera apart from the intestines in twenty-six instances. They seemed most numerous in the spleen, but variable in distribution in the other organs. Occasionally it required a large number of sections before a colony could be found, especially in the later stages of the disease. This explains why they were not found in the viscera of two other cases which had died at a very advanced period. In one of these two instances, there had been a relapse as indicated by fresh ulcerations in the intestines, and in these fresh patches the bacilli could again be detected. Gaffky attributes his success in finding the bacteria with such regularity to his staining methods, using concentrated solution, especially methyl-blue, and exposing the sections for a long time or warming them. He admits that the typhoid bacilli do not stain as deeply as other bacteria. They frequently contained spores. Micrococci-colonies were found but in a single case. The bacilli of Klebs were seen quite often, but only in the ulcerated patches, and extending thence into the bloodvessels. They were never seen in Peyerian patches or follicles not yet opened by ulceration. Hence Gaffky considers the invasion by either micrococci or Klebs's bacilli as secondary, though by no means harmless processes. They probably represent complications.

The typhoid bacilli were cultivated outside of the body without much difficulty. The spleen or some other organ was taken from the cadaver as soon as possible, washed externally with a solution of corrosive sublimate, sliced successively in different directions with knives previously heated, whereupon a needle previously heated was drawn across the surface and then used for inoculating gelatine. The gelatine was rendered nutrient by the addition of meat extract and pepton. The bacilli grew on this soil in the form of rounded colonies of a brownish tinge, without liquefying the gelatine. Transferred to the surface of a boiled potato slice, they formed a thin scum, not visible to the naked eye, which extended very rapidly over the surface. This mode of growth on potatoes was found very characteristic of the typhoid bacilli. They could also be cultivated in fluid blood serum or meat-broth, and less vigorously, it is true, in the decoction of various vegetables. These observations show that the typhoid bacilli are *not* limited to a parasitic mode of life in the bodies of human patients. The bacilli examined in a drop of fluid showed decided mobility swimming rapidly towards the edge of the drop, where they collected in groups. When cultivated at a temperature between 30° to 42° C. the bacilli formed spores, usually one at the end of each rod. With the pure cultures of these bacilli experiments were made on numerous animals of different species, including some monkeys. But it was not possible to produce typhoid fever in any animal by feeding or injection, or by any other mode of inoculation. In fact, no animal is known to take the disease spontaneously, and there is hence no immediate prospect of verifying the pathogenic properties of these bacteria by experiments on animals. But since these bacilli are invariably found in the diseased intestines and the internal organs during the progressive stage of typhoid fever, and since they have never been found in any other disease, Gaffky considers their causal relation to the disease as extremely probable, if not absolutely proven.

In the next place, Gaffky details his investigation of an epidemic of typhoid fever occurring in a body of soldiers stationed in Wittenberg. The essay is a beautiful model of what might be called "scientific detective skill." All chances of infection through the air, soil, food, and so on are carefully considered, but finally discarded on the strength of the evidence, which pointed in an unmistakable way to a well as the source of the epidemic. It was shown that this well could have been infected from an adjoining privy, for a communication between the two occurred through the intervening soil. In that privy the feces of a few typhoid cases had been emptied some months previously. The large demand for water from that well on account of the hot season and the sinking surface water evidently favored the transportation of the germs. The crucial test, however, the search for the bacilli in the well water by means of cultures on gelatine failed completely. The bacilli could not be found. Still this negative result was to be expected, for the majority of infections had occurred before Gaffky's arrival. Even if the period of incubation be assumed as short as two weeks, the water had lost its infectious properties before the search was begun, as could be traced by the date of the infections.

The last article of the volume is by DR. LŒFFLER, *On the Significance of Micro-Organisms in Diphtheria of the Human Race, of the Pigeon, and of the Calf.* A critical review of the literature shows that, up to the present time, scarcely anything is known with certainty as to the relation of specific micro-organisms to diphtheria. All observers have found bacteria in the membranes, but since the membranes are exposed to the air and to the fluids of the mouth, teeming with bacteria, this result must be expected, and proves nothing. As regards the kind of bacteria the statements vary; micrococci seem to have been most commonly found. The most positive observations are those of Klebs, communicated at the last congress of German physicians at Wiesbaden. With the use of staining methods he invariably found delicate rods in the deeper layers of the pseudo-membranes. The different cultivations of diphtherial virus hitherto attempted cannot inspire one with any confidence. Even the transmission of the disease to animals by means of the pseudo-membranes has not been successful in many instances. In internal organs bacteria have been found so rarely, that they must be regarded a complication in diphtheria.

Lœffler searched for bacteria in the pseudo-membranes and diseased mucous membranes, sometimes also in the viscera of twenty-seven cases of either pure diphtheria or scarlatinal diphtheria. Quite a variety of different micro-organisms were found, but mostly in such an arrangement that their invasion could not be considered as anything but a secondary affair. Two varieties, however, were met with some constancy, though not found in every case. One of these was a small micrococcus in chains, which penetrated usually through the pseudo-membranes into the mucous membrane. It was also found to some extent in internal organs. Pure cultures of it injected under the skin of animals produced some transient inflammation of not much consequence except in rabbits. In these animals a typical erysipelas was obtained by inoculation with these cocci, while their injection into the bloodvessels produced suppurative inflammation of joints. Since they cannot be distinguished from the micrococci of erysipelas by their mode of growth or their effects upon animals, Lœffler considers them either identical with or closely allied to the virus of erysipelas. Since they produced no result in animals comparable to human diphtheria or to the effect of inoculation with pseudo-membranes, they cannot be the cause of diphtheria. In Lœffler's opinion, they are the cause of a common complication in diphtheria, which complication might be considered as an erysipelas of the mucous membrane. The same parasites, giving rise, as far as can be judged, to similar complications, are found also as secondary invaders in other lesions of mucous membranes; for instance, in smallpox and typhoid fever. These rather startling statements may seem bold to clinicists, but cannot be disproved on clinical evidence alone. The position of the clinicist seems to the reviewer like that of a geologist who learns that in one of his specimens, well known to him by appearance, some new element has been detected by a competent chemist. Without a competent repetition of the chemical analysis, he would have no right to dispute the chemist's assertion.

The second variety of micro-organisms found with any regularity in pseudo-membranes were the delicate rods described by Klebs. From the position in which they were detected, it would seem most logical to accuse them as the cause of the disease, for they were found only in the deeper layers of the pseudo-membrane, but not extending into the lining membrane. They occurred, moreover, in the more typical cases of genuine diphtheria. But they are not met with in every instance. Lœffler suggests that they can be eliminated at an early period of the disease, as soon as the lesion ceases to be progressive, but he does not conceal the hypothetical character of this explanation. These rods occurred sometimes in the lungs when they were inflamed as a complication, but not often in other organs.

The bacilli were cultivated outside of the body. The only satisfactory soil on which they grew well was solidified blood-serum, with the addition of meat-broth, pepton, and grape-sugar. The growth required a temperature over 20 C°. They formed no spores, and their duration of life was limited to some three months.

Inoculation with the pure culture of these bacilli proved harmless to some species, but gave decided results in rabbits, guinea-pigs, and birds. Introduced under the skin, the parasites caused an intense inflammation, resulting in a fibrinous exudation. On intact mucous membranes they could not get a foothold, except in the vulva of guinea-pigs; but on inoculating them into the conjunctiva, or pharynx, or trachea, a typical growing pseudo-membrane was produced, with general involvement of the animal's health, usually terminating fatally. The disease was more readily produced in young than in older animals. The conclusion seemed inevitable that the bacilli produce some irritant poison, by the secretion of which the extensive local action and constitutional effect could be explained, for they were out of proportion to the limited number of bacilli actually found. Lœffler himself admits that his experiments do not prove in an unequivocal manner the causal relation of these bacilli to diphtheria, but considers that point at least as very probable. He sums up the arguments *pro* and *contra* as follows: (1) The bacilli were not found in every typical case of diphtheria, but they may have been eliminated, for such elimination occurs also in other bacterial diseases. (2) Their arrangement in the pseudo-membranes of rabbits and chickens was not as typical as in human diphtheria. (3) Mere application to the intact mucous membrane of susceptible animals did not produce infection, but we are not sure but that a preliminary minute lesion of the membrane is also necessary in man. Moreover, these animals have no organ like the human tonsil, with recesses and niches, where the parasites can start their vegetation. (4) None of the surviving animals ever presented any paralytic symptoms; but post-diphtheritic paralysis is also rare in man. (5) On examining, by means of cultures, the buccal mucus of twenty healthy children, the characteristic bacilli were found in one instance without diphtheria. But the presumption is not unreasonable that during the time of an epidemic a specific germ may reach the mouth of a child, and vegetate in the fluids, without gaining entrance into the mucous membrane, and causing the disease.

The article concludes with some observations on epidemics of a diphtheria-like affection in birds and in calves, due, however, to bacteria different from those of the disease in man.

Of the volume as a whole it can only be said that all its contributions are characterized by a thorough familiarity with the work done by others, a severe and generally unbiased criticism of the same, not any more sparing, however, with reference to the work done by the authors themselves, a remarkable amount of patient and well-directed work, guided by decisive logic, and, finally, a most cautious interpretation of results.

Those who are pleased to speak of the defenders of the germ-theory as theorists might be perplexed to point out many volumes each written page of which represents so much painstaking work as in these Mittheilungen. The plates, illustrating Koch's tubercle-bacilli and Hesse's analyses of the floating-matter in the air, come up to the general excellence of the volume. H. G.

ART. XIX.—*Traité Clinique de l'Inversion Uterine.* Par P. DENUCÉ, Doyen et Professeur de Clinique Chirurgicale à la Faculté de Médecine de Bordeaux; Membre correspondant de l'Académie de Médecine et de la Société de Chirurgie de Paris, etc. etc. Avec 103 figures intercalées dans le texte. Paris, 1883, pp. 644.

A Clinical Treatise on Inversion of the Uterus. By P. DENUCÉ, Dean and Professor of Clinical Surgery, etc. etc.

THE impulse which led to the production of this book is graphically set forth in the preface. A young woman appeared at the author's clinic who suffered from metrorrhagia, and had in the vagina a pediculated tumour of the size of a small pear. She had been sent by a medical man in whose judgment the author had confidence with a diagnosis of polypus. For many years she had resided in the same family, and bore a good reputation; not only was there nothing to cause the slightest suspicion, but she denied positively ever having been pregnant. The tumour was removed by the écraseur, not without, however, causing severe pain, which awakened doubts and fears. The doubts were confirmed and the fears realized; the patient died within forty-eight hours.

This condition could not, then, be sufficiently known or its symptoms analyzed, and the author set about an exhaustive study of the subject. He found that he was in good company! The same error had been com-